Overview of Chapter 5

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5.0 Introduction

This chapter discusses special requirements for three types of areas that are especially vulnerable to harm from contamination:

- Geologically susceptible areas
- Wellhead protection areas
- Ecologically susceptible areas

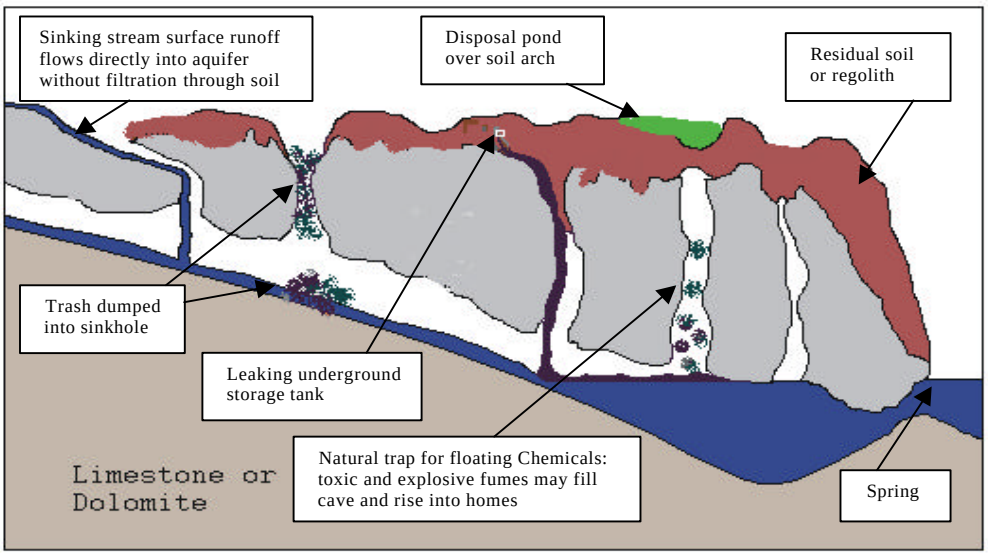
RISC has established these types of areas because people and some sensitive species are more likely to be affected by contamination released to a susceptible area. These areas are considered susceptible based on the characteristic unpredictability of contaminant transport mechanisms, the exceptional value of their environmental resources, or increased human or ecological risks that may result from contamination.

If COC concentrations detected in a geologically or ecologically susceptible area exceed estimated quantitation limits (EQL), the area must be evaluated through a nondefault risk assessment; the nondefault risk assessment must be designed for the unique conditions in the susceptible area. The risk assessment must include potential COC transport mechanisms to determine how contamination could potentially affect the susceptible area. Transport mechanisms include any means that allow contamination to migrate, such as any natural or constructed conduit that contamination may follow between points. Examples of transport mechanisms include wind erosion, leaching through soils and backfill, and transport through sewers and drainage ditches.

The following sections discuss the three types of susceptible areas and the special considerations and requirements associated with each of them.

5.1 Geologically Susceptible Areas

Geologically susceptible areas (see Figure 5-1) are characterized by conditions that allow contaminants to migrate away from the source area in such a manner that invalidates the assumptions of the soil-to-groundwater partitioning model used to calculate the default closure levels.



Modified from Hoffman, W. 1989. Karst Landscape of Warren County

Figure 5-1. Geologically Susceptible Area

Examples of geologically susceptible areas include karst terrain, mined areas, and other fractured rock geology where conduit ground water flow occurs.

Definition of Karst Terrain

The Federal Register notice provides the following definition of karst terrain (40 CFR 258.15(b)(5), October 9, 1991):

"Karst Terrains" means areas where karst topography, with its characteristic surface and subterranean features, is developed as the result of dissolution of limestone, dolomite, or other soluble rock. Characteristic physiographic features present in karst terrains include but are not limited to sinkholes, sinking streams, caves, large springs, and blind valleys.

Karst terrains are prevalent in southern Indiana. The presence of *any* of the distinctive surface or subsurface features listed below is sufficient to identify a terrain as karst. However, the lack (or apparent lack) of surface topographic karstic features does not mean an area is not a karst terrain. Karst terrains are typically characterized by the following:

- Sinkholes — Any closed depression, with or without a discrete opening at the bottom, formed by dissolution or collapse of bedrock, with flushing or collapse of soil into a subjacent cavity and internal drainage to the ground water system
- Dry valleys in humid climates
- Springs draining carbonate, sulfate, or halide rocks
- Sinking streams that flow underground at a hole known as a swallet or swallow hole
- Caves — Open to the surface or accidentally encountered during drilling
- Joints or bedding planes enlarged by dissolution (as seen in drilling cores or outcrops)
- Grikes — Soil-filled joints or grooves enlarged by dissolution, also known as cutters or soil karren
- Karren — Dissolutionally, subaerially, water-carved grooves on rock, commonly subparallel

Karst terrains are especially susceptible to contamination because the openings and conduits formed by the disintegration of rock allow contaminants to enter and move rapidly through a ground water system. Furthermore, ground water systems in karst terrains are typically quite complex and may disperse contamination unpredictably. An example of karst terrain in southern Indiana is the Lost River System.

If contamination is present which could affect a geologically susceptible area, special consideration must be given when determining appropriate closure levels for affected media. The soil-to-ground water partitioning model for evaluating indirect contact exposure is not valid for such areas. Likewise, an evaluation of ground water plume stability may not be possible using the default guidance. As a result, default closure levels for indirect contact and the default stability monitoring approach do not apply at these areas.

5.2 Wellhead Protection Areas

Records and locations of Wellhead Protection Areas can be obtained from the Drinking Water Branch of the Indiana Department of Environmental Management. Figure 5-2 illustrates a typical wellhead protection area.

Definition of Wellhead Protection Areas

The Indiana Wellhead Protection Rule (codified at 327 IAC 8-4.1) defines a wellhead protection area as follows:

Wellhead Protection Area means the surface and subsurface area, delineated by fixed radius, hydrogeological mapping, analytical, semianalytical, or numerical flow/solute transport methods, which contributes water to a community public water supply system production well or wellfield and through which contaminants are likely to move and reach the well within a specified period.

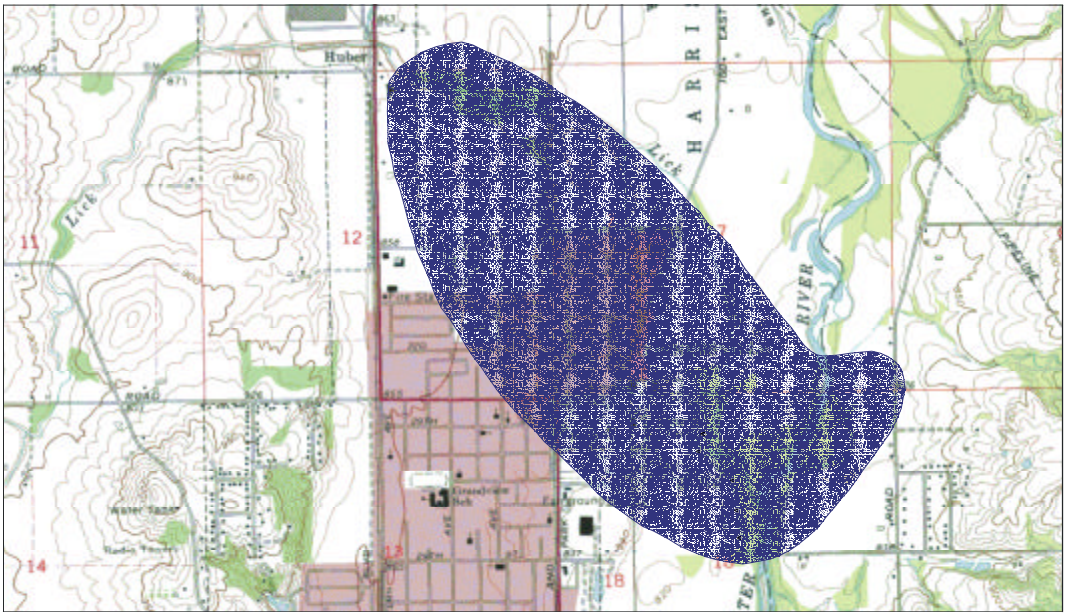


Figure 5-2. Wellhead Protection Area

In cases where ground water contamination is demonstrated to be stable or declining, it may be possible to pursue site closure through implementation of institutional controls. However, because Wellhead Protection Areas provide actual sources of drinking water, they present a high probability for human exposure. As a result, within a Wellhead Protection Area, closure with institutional controls is generally not appropriate. For sites where it can be demonstrated that COCs will attenuate before they migrate to any wellpoint within a Wellhead Protection Area, it may be possible to implement a closure with institutional controls, with the concurrence of the public water supply authority and IDEM. For other sites, it may be feasible to install a treatment system at the wellhead with the concurrence of the public water supply authority.

5.3 Ecologically Susceptible Areas

Ecologically susceptible areas are areas with special habitats where the effects of contamination on nonhuman receptors must be considered. Figure 5-3 illustrates a typical area that may be ecologically susceptible. The box below provides additional information that may be useful for defining ecologically susceptible areas.

Additional Information Useful for Defining Ecologically Susceptible Areas

Surface Waters of the State

Surface waters of the state include rivers, streams, creeks, free-flowing underground streams, reservoirs, lakes, and wetlands, (see 327 IAC 2-1-9[42] and 327 IAC 2-1.5-2[79]. All surface waters of the state must comply with all water quality standards contained under 327 IAC 2, including use designations, numeric and narrative water quality criteria, and the antidegradation standard.

Some examples of ecologically susceptible areas include the following:

- National and state parks, forests, and wildlife refuges
- Designated state nature preserves and other protected areas

- Critical habitats for endangered or threatened species, or species of special concern
- Prairie areas
- Dune areas (such as those near Lake Michigan)

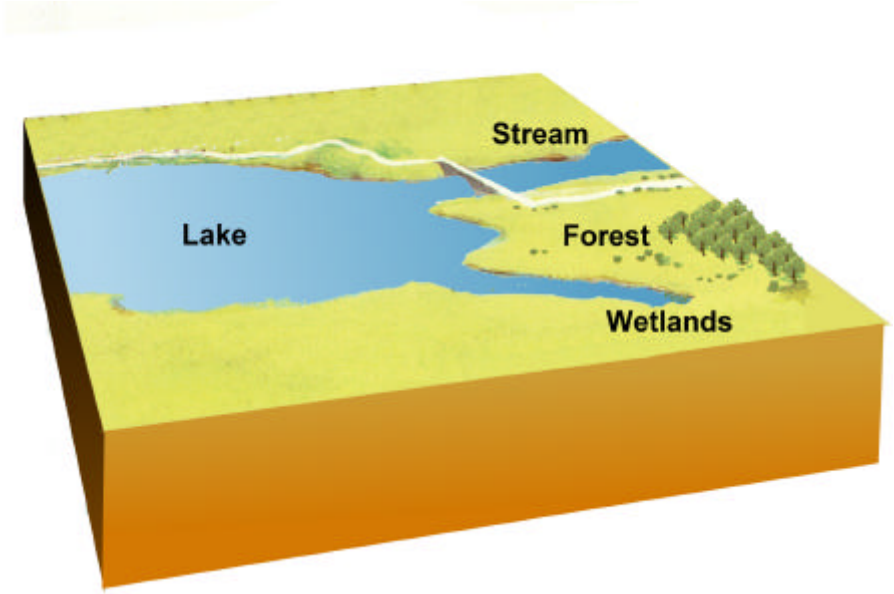


Figure 5.3 Ecologically Susceptible Area

- Surface waters of the state, including wetlands and free-flowing underground streams
- Sinkholes or karst recharge areas *(These areas may be ecologically susceptible in addition to being geologically susceptible.)*
- Riparian areas
- Breeding areas for nesting birds, aquatic birds, aquatic mammals, amphibians, or reptiles
- Migratory areas for shorebirds, aquatic birds, raptors, or passerines
- Wintering areas for migratory waterfowl or other aquatic birds
- Hatcheries

- Reservoir areas
- Recreation areas
- Other designated critical biological resource areas

The box below provides contact information for (1) national parks, forests, and wildlife refuges; (2) state parks, nature preserves, and other protected areas; and (3) endangered, threatened, and rare species and species of concern.

<table>
<tr><td colspan="3">For a listing of national parks, forests, and wildlife refuges, contact the following:</td></tr>
<tr><td>U.S. Department of Fish and Wildlife
Bloomington Field Office
620 South Walker Street
Bloomington, IN 47403
(812) 334-4261
http://www.fws.gov</td><td>U.S. Park Service
Midwest Region
1709 Jackson Street
Omaha, NE 68102
http://www.nps.gov</td><td>U.S. Forest Service
310 Wisconsin Avenue
Room 500
Milwaukee, WI 53203
http://www.fs.fed.us</td></tr>
<tr><td colspan="3">For a listing of state parks, nature preserves, and other protected areas, contact the following:</td></tr>
<tr><td colspan="3">Indiana Department of Natural Resources
402 West Washington Street
Room W298
Indianapolis, IN 46204
(317) 232-4020
http://www.state.in.us/dnr</td></tr>
<tr><td colspan="3">For a listing of endangered, threatened, and rare species and species of special concern, contact the following:</td></tr>
<tr><td colspan="2">Indiana Department of Natural Resources
402 West Washington Street
Room W273
Indianapolis, IN 46204
(317) 232-4091
http://www.state.in.us/dnr</td><td>U.S. Department of Fish and Wildlife
Bloomington Field Office
620 South Walker Street
Bloomington, IN 47403
(812) 334-4261
http://www.fws.gov</td></tr>
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5.3.1 Baseline Ecological Evaluation

The applicability of human health-based closure levels at every site is contingent upon a determination that ecological concerns have been accounted for. This may be accomplished without conducting a comprehensive ecological risk assessment at every site. The procedure outlined on the following pages is intended to provide a relatively simple approach for making this determination. The first step in this

procedure is to conduct a baseline ecological evaluation.

A baseline ecological evaluation is included as part of the presampling activities (see Chapter 2). The baseline ecological evaluation consists of a desktop review and site inspection to determine if ecologically susceptible areas are present in the site vicinity, and if such areas could potentially be affected by COCs at the site.

If ecologically susceptible areas are not in the site vicinity, and if there is no potential for ecologically susceptible areas beyond the site vicinity to be affected by COCs at the site, default closure levels can be used. If ecologically susceptible areas could potentially be affected by the source area, a limited ecological assessment must be conducted. Figure 5-4 provides a flow chart depicting the steps involved in evaluating ecologically susceptible areas.

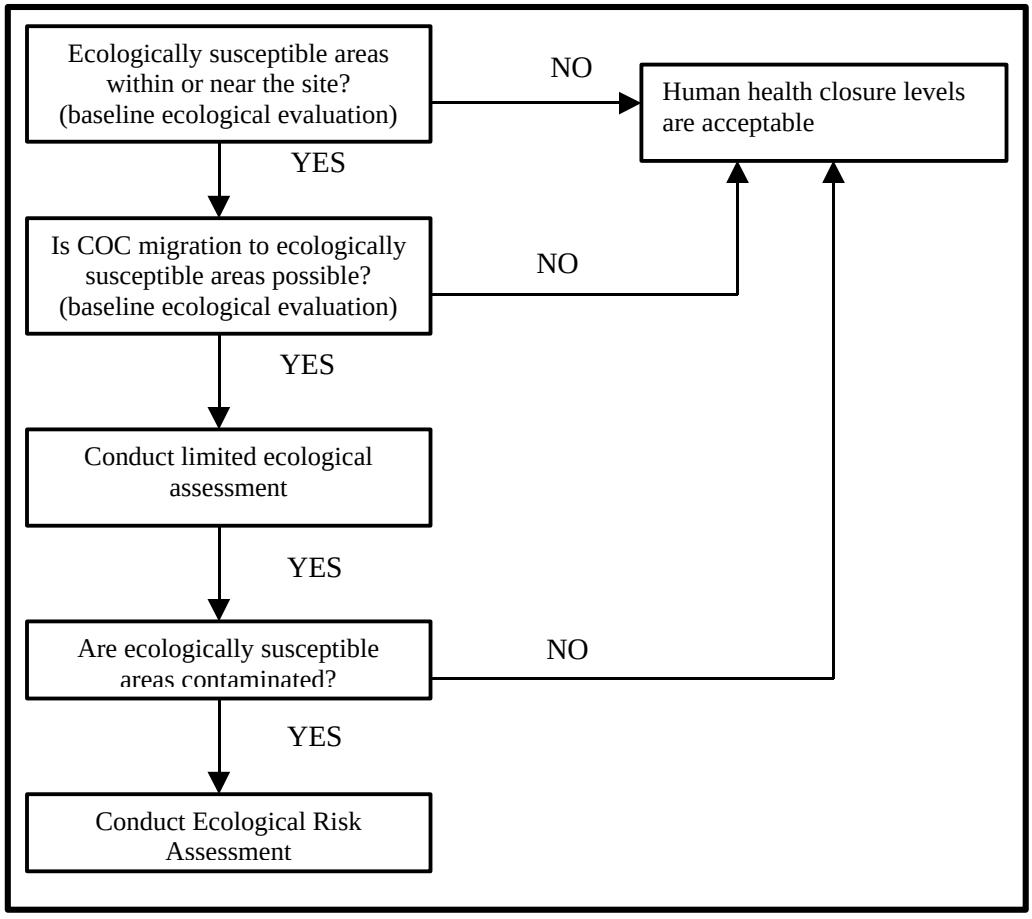

Figure 5-4. Steps Involved in Evaluating Ecologically Susceptible Areas

5.3.2 Limited Ecological Assessment

If ecologically susceptible areas are present onsite, or if there is a potential for COCs to migrate to an ecologically susceptible area, the impact or potential impact of contamination must be assessed. As appropriate, the limited ecological assessment should include sampling of soil, sediments, surface water, and ground water at the ecologically susceptible area, and along areas that may serve as a pathway from the site to any ecologically susceptible areas. Impact or potential impact will be assumed if sampling results indicate (1) that a COC is present in the ecologically susceptible area or (2) there is a potential for a COC to migrate to any ecologically susceptible area.

If actual or potential impacts are discovered, an ecological risk assessment will be necessary to establish appropriate closure levels.

5.3.3 Ecological Risk Assessment

If results of the limited ecological risk assessment indicate an actual or potential impact to an ecologically susceptible area an appropriate ecological risk assessment should be conducted. This should be performed by an environmental professional experienced in ecological risk assessments. While ecological risk assessment guidance is not offered within this Technical Guide, IDEM suggests following procedures outlined in "Guidelines for Ecological Risk Assessment" (EPA 1998) as well as other appropriate EPA guidance documents.